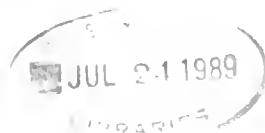




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Informal Technology Transfer Between Companies:
Information Leakage or Know-How Trading?

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Abstract

Employees frequently provide colleagues working in other companies with specific technical information or advice. This paper addresses the question whether or not this information transfer is in the economic interests of the involved companies.

First, informal information transfer is discussed as a firm-level phenomenon. Four factors are found to determine the economic usefulness of this information transfer: the information content, the competitive relationship between the involved companies, the availability of other information sources, and the willingness and ability of the receiving party to return valuable information.

Second, data on specific information transfer decisions is provided through analysis of a survey of 294 technically oriented middle-level managers from the U.S. minimill and specialty steel industry. The findings are that employees' information exchange behavior apparently is directed towards their companies' economic interests. Furthermore, the data suggest a positive link between the participation of a company's employees in informal information transfer networks and the economic performance of the company.

* I am thankful to Professor Eric von Hippel, Massachusetts Institute of Technology, who inspired me to work in this field with his ground-breaking study on informal know-how trading and who has provided immeasurable help and encouragement ever since then. I am also grateful to my "doctorfather" Professor Eberhard Witte, Munich University, for his longstanding support and advice. In addition, I would like to thank Professor Anne Carter of Brandeis University, Dietmar Harhoff, PhD candidate at MIT's Sloan School of Management, and Henrik Sattler, Doctorand at Kiel University, West Germany, for their helpful comments and suggestions. Finally, I want to express my appreciation to Jessie von Hippel and to Steve Strang for their editorial help throughout the writing process.

1 Introduction

Technical information about product characteristics and specifics of the production process tends to spread rapidly within an industry.¹ In some instances the information flow between companies takes place via formal agreements such as licensing agreements. These agreements have been analyzed extensively in existing research.² But in many instances technical information spreads through informal channels, for example, at conferences where employees might exchange valuable information or in the legendary Silicon Valley bar. This paper investigates one specific kind of technology transfer: the informal person-to-person information transfer between employees who are working for different, often competing companies within one industry.

In general, economic and management researchers regard this informal information transfer as a problem for the companies whose employees are transferring the information. Mansfield, for example, labels this kind of transfer "leakage of information."³ He argues that the rapid diffusion of technology via informal channels is one reason for firms having difficulties in appropriating much of the social benefits from their innovations.

On the other hand, von Hippel suggests that informal information transfer may well be in the companies' interest.⁴ A pilot study in the steel-minimill industry and anecdotal evidence from other industries, such as waferboards and aerospace, leads him to propose that employees actually trade information based on reciprocity. He demonstrates with the help of a Prisoner's Dilemma model that under specific circumstances companies might gain from such trades.

In a recent article, Carter develops the concept of know-how trading further and shows in an economic framework that "knowhow trading works in such a way that some major deterrents to knowledge sharing are minimized."⁵

¹ Mansfield, 1985.

² For example Katz/Shapiro, 1984; Schmalen, 1980.

³ Mansfield, 1985, p. 219.

⁴ Von Hippel, 1987 and 1989.

⁵ Carter, forthcoming.

But she also points out that it remains uncertain whether or not individuals are actually exchanging information in the best interest of their respective firms.¹

It is thus important to determine whether the informal information transfer between companies constitutes information leakage or know-how trading. If it is leakage, then companies might well want to prevent it. If it is trading, companies might well support it.

In this paper, a two-step approach is used to explore empirically whether the information exchange behavior of employees is directed towards their companies' economic interest: First, I investigate the usefulness of information transfers between companies from a firm-level perspective. Four factors will be discussed that determine whether or not an information transfer might be in a company's interest: the information content, the competitive relationship between the involved companies, the exclusiveness of the information, and the willingness and ability of the receiving party to return valuable information. For each of the four factors, the results of this firm-level analysis are then contrasted with actual behavioral tendencies that I have observed through surveying 294 middle-level managers working in the U.S. minimill and specialty steel industry. My findings are that, in the surveyed industry, employees' information exchange behavior supports their companies' economic interest (section 4).

This result is backed by additional empirical evidence from the same survey. The evidence suggests that companies whose employees are actively participating in the informal information exchange are performing economically better than companies whose employees do not use these information networks (section 5).

Finally, the findings are put into perspective and implications for management will be drawn (section 6). But before starting the investigation, I present the research methods (section 2), and I examine whether informal information transfer between companies is an important enough phenomenon to deserve our attention (section 3).

¹ Carter, forthcoming.

2 Research Methods

The empirical data are drawn from the U.S. minimill and specialty steel industry.¹ The data collection methods used consist of open interviews during the pilot study followed by a questionnaire survey.

The purpose of the open interviews was to get a preliminary understanding of the way in which information is transferred in the investigated industry. Altogether, 44 top- and middle-level managers were interviewed at this stage.

A mail questionnaire was then used to acquire a more systematic understanding of the information transfer decision. The survey data provided the empirical basis for testing the general hypothesis that employees' information exchange behavior is, within this specific industry, directed towards the economic interest of their companies. A confirmation of that hypothesis would imply at the same time that the information-leakage hypothesis (the hypothesis that informal information transfer reduces the appropriability of innovation benefit) cannot be sustained.

The questionnaire was sent to 477 employees. These were all middle-level managers who worked with minimill and specialty steel companies and who were listed in the 1986 Directory of Iron and Steel Plants as being directly responsible for technical aspects and not belonging to top management. Top management was not included in the sample since the pilot study had led to the conclusion that top-level managers do not participate actively in the exchange of *technical* information.

In the questionnaire, the surveyed employees were not asked to provide explanations for their information transfer behavior since this would have led quite likely to invalid results caused by post-rationalization. Rather, an indirect approach towards understanding their behavior was chosen: Half of the surveyed employees were asked to think back to the last instance when somebody from

¹ For a more detailed description of the research methods and for a characterization of the minimill and specialty steel industry see Schrader, 1989.

another steel company had requested technical information and they *had provided* the desired information (version 1 of the questionnaire: transfer situation). The second half was asked to think back to the last instance when they had been asked for information and they *had not provided* it (version 2: no-transfer situation). Both situations were to be described in terms of the same theoretically and empirically derived variables, using primarily 7-point scales (Figure 1). The underlying assumption of this approach is that by contrasting the transfer situations with the no-transfer situations, systematic differences might be detectable.

Sample Questions							
Please indicate to which extent the following statements are accurate descriptions of the information the other person asked for.							
	not at all accurate		somewhat accurate		very accurate		
He could have gotten this kind of information from another source, for example, from another steel company or from a vendor.	1	2	3	4	5	6	7
It would have been easy for him to come up with a similar solution.	1	2	3	4	5	6	7

Figure 1: Format of the questions

The questions about details of a specific information request were supplemented by others about general characteristics of the employee and about his¹ overall evaluation of the informal information transfer between companies.

The questionnaire was mailed to the selected managers in August 1987. In 29 cases, the employee could not be reached or had retired. Thus, 448 employees could have answered; 297 returned the questionnaire, of which 294 were usable, yielding an effective response rate of 65.6 per cent (64.7 per cent for version 1, transfer situation; 66.5 per cent for version 2, no-transfer situation).

¹ I use the male pronoun since all surveyed employees were man.

3 Importance of Information Transfer Between Companies

Is the informal information transfer between companies an important phenomenon, worth studying, or is it just a marginal occurrence? The surveyed managers were asked to indicate on a 7-point scale the importance they attribute to colleagues in other steel companies as information sources. 61 per cent of the surveyed managers considered colleagues in other companies to be an important information source. (They indicated at least a value of 5 on a 7-point scale with 1 meaning "not at all important" and 7 meaning "very important").

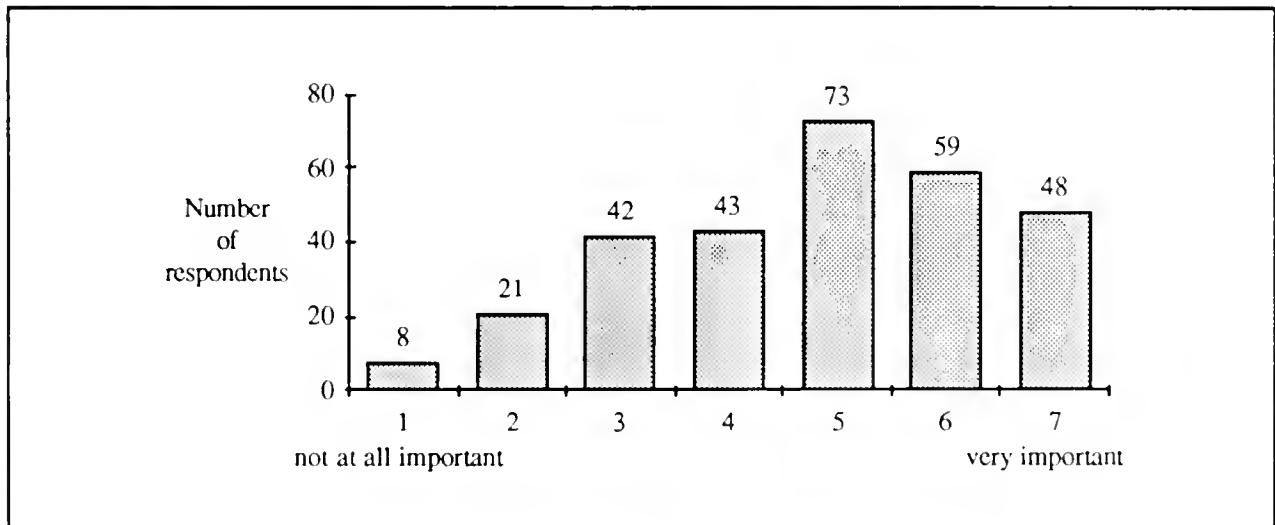


Figure 2: Importance of the informal information transfer between companies for the surveyed managers

External contacts are not only an important information source for the surveyed employees, but they themselves are also sought after as an information providers: 85 per cent reported that at least once during the year before the survey they had been asked by a colleague working in another company for some

specific technical information. Nineteen per cent of the respondents had been asked 10 or more times. Of all the employees who had been sought after as an information source by their colleagues, only 2 per cent had never provided the desired information. Thus, 83 per cent of the surveyed employees had served at least once during the period of investigation as information providers to colleagues in other steel companies.

Apparently, the employees themselves consider the informal information transfer to be important. But is this also reflected in the specific cases which have been characterized by the surveyed managers? To answer this question, the employees who received a questionnaire inquiring about a transfer situation were requested to indicate their estimate of the importance of the transferred information to their own companies and to the company of the information receiver. The majority of the respondents classified the transferred information in both categories as important or even very important (indicated value equal to or larger than 5, see Figure 3).

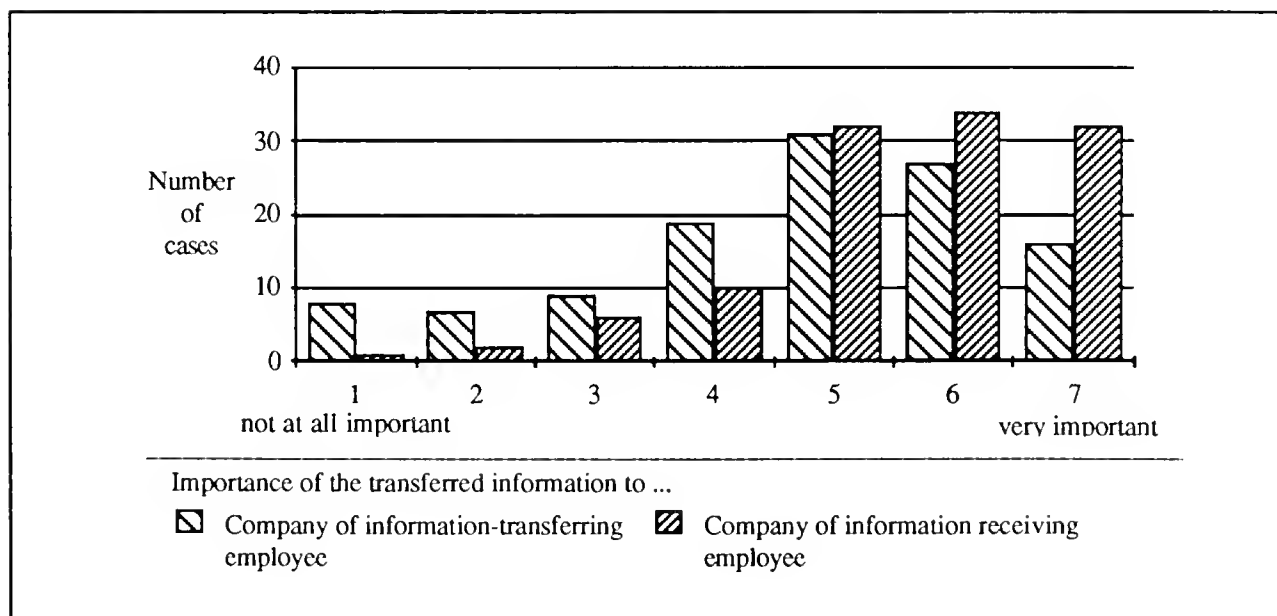


Figure 3: Importance of the investigated information transfers as evaluated by the transferring employee

It is interesting to note that, on average, the surveyed employees considered the transferred information to be of greater importance to the information receiving company (mean= 5.6) than to the transferring one (mean=4.7; $p<0.001$). If these perceptions are reliable, then this suggests that the industry as a whole is gaining through such transfers, even if transferring information would eliminate the value of the information for the transferring company completely.

Summing up, four points can be made:

1. The majority of the surveyed managers participate in the informal information transfer between companies.
2. The majority of the surveyed managers consider this kind of information transfer to be important.
3. In the majority of the described cases, the transferred information was, in the view of the surveyed employees, of considerable importance for the involved companies.
4. If employees perceptions are valid, than the industry as a whole gains from information transfer between companies

4 Companies' Interest and Employees' Information Transfer Behavior

In this section, the usefulness of an information transfer between companies is first examined from a firm's perspective. For this, the assumption is made that employees act as perfect agents of their companies. Thus, the reasoning to be presented proceeds as if companies are the units that decide whether or not to provide information. In this analysis, information transfers are found to be valuable to a company under certain conditions.

The results of this firm-level analysis are then compared with the observed information exchange behavior of the surveyed employees. The data indicate a close alignment of companies' interest and individuals' information exchange behavior.

The starting point for the following firm-level analysis is the decision of a firm (designated as A) whether or not to provide another firm (B) with a specific unit of information. This decision will be called a *transfer decision*. As pilot interviews with 44 managers from the steel industry have shown, the need for a transfer decision is generally initiated by an information request, i.e., an inquiry for some information by an employee from another company.

For firm A, the one responding to the information request, a transfer decision may generate costs and benefits in at least two ways: First, an information transfer might change the *economic value of the information* for the transferring firm.¹ Second, the transfer decision and the subsequent hiding or revealing of the desired information might influence the firm's long-term relationship to the inquirer. The transfer decision can make it more or less likely that the inquirer himself will provide information in the future. The amount of benefit which the firm that possesses the information expects to gain from its relationship with the inquirer reflects the *instrumentality of the relationship*. A transfer decision might change this instrumentality.

Figure 4 conceptualizes the relationship between the transfer decision and the induced variations of the information's value and of the instrumentality of the exchange relationship.

¹ Von Hippel, 1989, pp. 85-88.

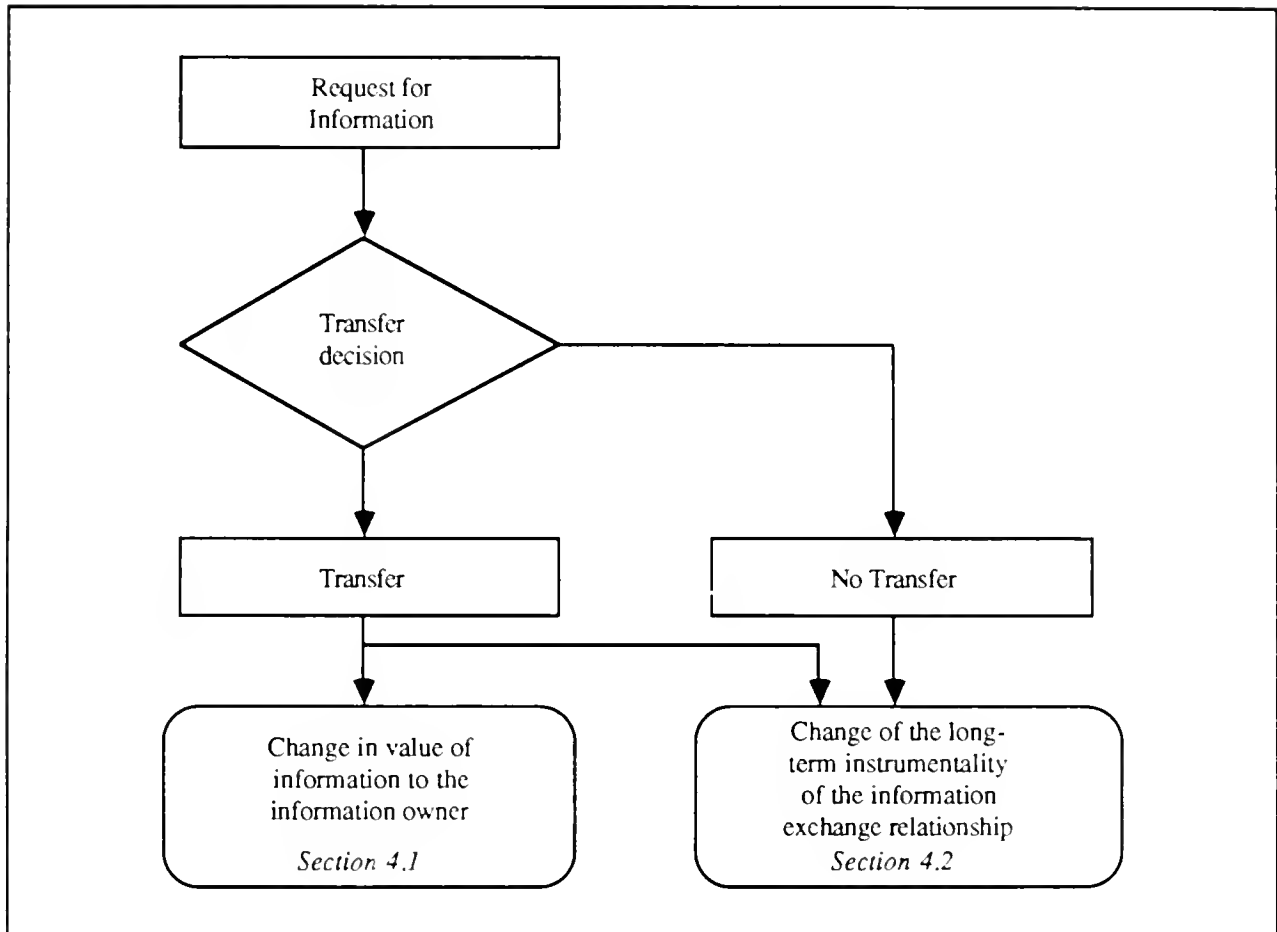


Figure 4: Impact of the transfer decision on the value of the information and on the instrumentality of the exchange relationship

4.1 Change of the Information's Value

For an information transfer decision, the absolute value of the information is not relevant. What is relevant is the change in the value of the information caused by the transfer. The firm does not lose the information by transferring it, but a transfer might alter the value of the information to the firm. Such a change in value can be measured by the change in the profits of the firm due to the transfer.

Under some circumstances, transferring information reduces the information's value to the transferring firm; under other circumstances the value

is likely to be unaffected.¹ In this section I will discuss factors which influence the degree to which the value of information is altered by a transfer.

An information transfer affects the profits of the transferring firm A only if the receiving firm B uses this information for actions which shift the relative competitiveness of the two firms (or if B hands on the information to a third party which might be a competitor of A). At this point it is important to note that an increase of the receiving firm's profitability in itself does not have any direct impact on the profit of the information-transferring firm. Only if the receiving firm uses this profit increase for measures which create a disadvantage for the transferring firm, only then the profits of the transferring firm are affected.

At least three factors influence the degree to which an information transfer affects the profits of the transferring company and thereby changes the value of the information: the level of competition between the involved firms (section 4.1.1), the information content (section 4.1.2), and the exclusiveness of the information (section 4.1.3).

4.1.1 Level of Competition

Transferring information to a non-competitor can lead to vastly different economic consequences for the transferring company than transferring the same information to a competitor. Providing a non-competitor with information does not reduce the transferring firm's profits (and thereby the value of the transferred information to this firm), as long as the receiving party does not hand on this information to a competitor. Can the transferring firm expect the information receiver not to disseminate the information further? In the pilot study the interviewees frequently pointed out that there is an implicit behavioral rule, stating that information which one firm has received from another firm should not be handed on to a third firm. The information receiver might provide third parties only with information about the availability of the specific piece of technical know-how, referring them to the original source. Thus, transferring

¹ For examples see von Hippel, 1987 and 1989.

information to another company does not necessarily turn the information into a public good. Given these circumstances, a firm is not likely to lose anything if it provides information to another firm with which it is not competing.

This may change if the receiving firm is a competitor. Take, for example, the transfer of some quality-related information. Receiving this information might enable the competitor to improve product quality and thereby to increase its market share at the expense of the transferring firm. In such a situation the information's value to the original owner is reduced by the information transfer. The information no more provides its owner with a competitive advantage relative to the information receiver. Thus, transferring information to a competitor tends to be costlier than transferring information to a non-competitor.

In this light, the likelihood of an information transfer should lessen with an increase in the degree of competition between the involved firms, providing the proposition is correct that employees' information transfer behavior furthers their companies' economic interest.

To test this hypothesis a measure for the degree of competition was developed. In the questionnaire, each employee was asked to indicate if his firm fabricated the same line of products as the inquirer's firm and whether both were addressing the same customer group. Using this information, an indicator for the intensity of competition was computed with 1 meaning "no competition" and 7 meaning "high competition".¹

The survey reveals that transfer situations are on average characterized by a significantly lower degree of competition between the involved firms than no-transfer situations (Figure 5). This observation supports the proposition that employees trade technical know-how within the bounds of their firms interest rather than just letting it leak out.

¹ For details see Schrader, 1989.

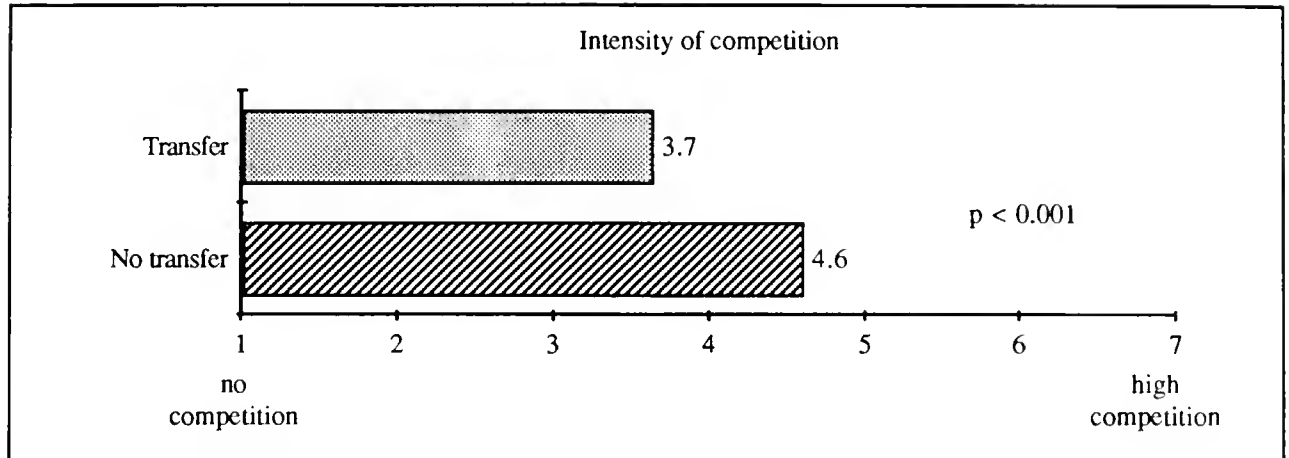


Figure 5: Average degree of competition and transfer decision

It is interesting to note that for the transfer situations the average degree of competition is still quite considerable (mean=3.7), and that 44 per cent of the transfer situations are characterized by a value of competition above 4, as can be seen in Table 1:

	Low competition (Degree of competition ≤ 4)	High competition (Degree of competition > 4)	Σ
Transfer	71	44	115
No Transfer	32	52	84
Σ	103	96	199

Chi-square = 10.9; p < 0.001

Table 1: Degree of competition and transfer decision

Apparently, under some circumstances employees exchange information even if their companies compete. In the two following sections I show that this might not violate the interest of their companies since not all information loses its value for its owner once transferred to a competitor.

4.1.2 Information Content

Conceptually, information can be divided up into two categories: Quality-related information and cost-saving information. Quality-related information has an impact on product characteristics; cost-saving information merely helps to reduce production costs.

Let us first analyze how a transfer of cost-saving information impacts the transferring firm's profits. Such an information transfer enables the receiving firm to reduce its production costs. A decrease of the receiver's production costs has negative consequences for the transferring firm only if the cost reduction makes the receiving firm to implement measures which affect inversely the market position of the transferring firm. Such measures might be, for example, price cuts or improvements of product characteristics.

Is it likely that the receiving company will turn cost savings into a price decrease and thereby capture a market share away from the transferring firm? Theoretically, abstracting from fixed costs, barriers to exit, and capacity constraints, a firm that can reduce its costs is able to capture the whole market by charging slightly less than its competitors.¹

This simplifying description does not apply to industries employing specific equipment, equipment which cannot be sold easily, which has to be maintained, and which ties up capital. These industries are characterized by significant barriers to exit and considerable fixed costs. Under such conditions, a firm is not likely to accept losing its market share due to a small price cut by a competitor. Rather, the firm will match the price decrease. Only if matching the price cut is more expensive than leaving capacity unutilized or exiting the market altogether, only then may the competitor profit from the price decrease. In addition, another condition has to be fulfilled for a price cut to be beneficial: The price-cutting firm must be in a position to serve the additional demand. Under some conditions, this might require to enlarge capacity. But enhancing capacity pays only if the connected costs do not outbalance the additional profit due to the increased market share.

¹ Tirole, 1988.

In this light, passing cost savings on to the customer is only in the information-receiving firm's interest if the price decrease is so radical that other companies are unable to match it, i.e., if the price decrease can be used as a strategic weapon for realizing a long-term, sustainable market share growth.¹ In the steel industry barriers to exit are very high and it is quite costly to adjust capacity. Therefore, transferring cost-saving information is not likely to lead to price-initiated changes in the competitive position of companies, an exception being radical cost-savings.

Still, transferring cost-saving information would be of disadvantage for the transferring firm if the receiving firm used the information for financing actions such as quality improvements or advertising campaigns. Yet, if a specific measure really promises an advantage for the receiving firm, then it is likely that this measure would have been financed anyway, an exception being firms under severe budget constraints.

The line of reasoning presented so far can be summarized as follows: Transferring cost-saving information can be expected to cause a profit increase for the receiving company. But this increase does not occur at the expense of the transferring company. Its profits are likely to remain unaffected. Thus, transferring cost-saving information can be expected to be a Pareto-preferred measure for the involved companies: it helps the information receiver and does not harm the information provider.

Does the same line of argumentation also hold true for quality-related information? Quality-related information enables improvements of product characteristics. Thus, contrary to cost-saving information, this information may directly affect product attributes that are (or may be) visible to costumers. Transferring quality-related information to a competitor may put that competitor into the position to sell a more attractive product. This might have negative consequences for the firm that transferred the information. Through enabling a competitor to sell a better product, the transferring firm is likely to weaken its own competitive position. Consequently, transferring quality-related information

¹ Porter, 1985, p. 510.

is unlikely to be Pareto-preferred: The receiving firm is gaining but the transferring firm is expected to lose.

To sum up: Transferring cost-saving information and transferring quality-related information are both likely to increase the receiving firm's profits. In the case of cost-saving information this increase is not expected to be accomplished at the expense of the transferring company. This is different for quality-related information. In this case it is likely that the transferring firm's profits decrease due to the improved quality of the information receiver's products. Given this, it should be expected that cost-saving information is more likely to be transferred than quality-related information.

Let us now turn to the actual information transfer behavior of the surveyed employees. Do they distinguish between cost-saving and quality-related information and are they more likely to transfer the former than the latter?

Apparently, in the vast majority of the described information transfer decisions the requested information related to both cost saving and quality improvement. In only 48 of the 204 characterized information requests¹ the information was classified as either predominantly cost-saving related or as predominantly quality-improvement related. In the remaining cases, the information was both cost-saving and quality-related.

Analyzing the 48 classifiable cases shows that more than two thirds of the requests for cost-saving information were fulfilled, whereas nearly two thirds of the inquiries for quality-related information were refused (Table 2).

¹ The questionnaire was designed in such a way that not all surveyed employees had to describe an information request: In 44 cases the employee had not been asked for information during the year before the survey; in 43 cases the employee was asked to describe a no-transfer situation although he indicated that he had fulfilled all information requests; and 3 employees were requested to describe a transfer situation although they had rejected all information inquiries during the year before the survey. Thus, the survey yielded 204 characterizations of information requests, of which 109 referred to transfer situations and 85 to no-transfer situations.

	Requested information relates primarily to ...			Σ
	cost savings (number of cases)	quality improvements (number of cases)	quality improvements and cost savings (number of cases)	
Transfer	71.4% (20)	40.0% (8)	58.3% (91)	58.3% (119)
No transfer	28.6% (8)	60.0% (12)	41.7% (65)	41.7% (85)
Σ	100% (28)	100% (20)	100% (156)	100% (204)

Table 2: Information content and transfer decision

It can be concluded that the information content has an impact on the surveyed managers' information transfer decisions. If a manager can expect that the transfer of some specific information (such as cost-saving information) is likely to benefit the receiver without creating a disadvantage for his company, he is more inclined to exchange it than he would be if he expected that his company were be harmed by the transfer (as it is likely in the case of quality-related information).

4.1.3 Exclusiveness of the Information

Transferring information may reduce the information's value to its owner since the transfer diminishes the information's exclusiveness; that is, the company can no longer capitalize on a competitive advantage caused by an informational lead relative to the information receiver.¹ Yet, information transfer is not the only way by which the exclusiveness of some specific information can be

¹ Brockhoff, 1988, pp. 56-60.

lessened. The competitive advantage caused by an informational lead would also be lost if the information inquirer were able to acquire the same or similar information through some other channels.

Consequently, the degree to which a transfer changes the information's value depends in part upon the length of the time span for which the information would have provided its original owner with a know-how advantage relative to the inquirer. The shorter this time span, the smaller will be the change in the value of the information caused by a transfer -- everything else being equal.

The expected length of a know-how advantage depends at least upon two factors: first, the likelihood that a competitor will develop similar knowledge through his own R&D activities, and second, the probability that he could receive equivalent information from other external information sources.

If the proposition is true that employees' information exchange behavior supports their companies' interest, then it should be expected that information which provides only a short-term competitive advantage is more likely to be exchanged than information which supposedly provides a long-term advantage. Consequently, the likelihood of an information transfer should increase with (a) the probability that the inquirer could generate similar information through his own R&D activities and (b) the possibility that he could acquire similar information from other external sources.

To test these two hypotheses, the surveyed employees were requested to indicate on 7-point scales if the information inquirer would have been able to develop a similar solution by himself and if the inquirer could have gotten the requested information from another external source as well (for the phrasing of these questions see Figure 1).

As predicted by hypothesis (b), transfer situations are characterized on average through a greater availability of alternative external information sources than no-transfer situations (Figure 6). On the other hand, hypothesis (a) is not supported by the data. No significant difference between transfer and no-transfer situations could be observed in regard to the likelihood that the inquirer could develop a similar solution by himself.

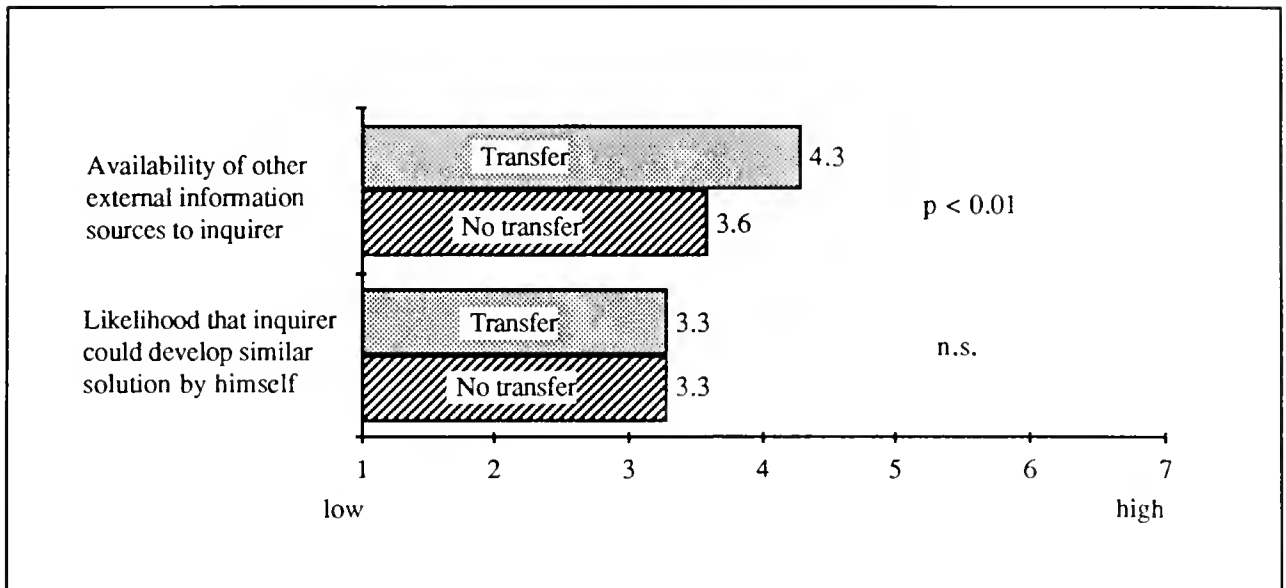


Figure 6: Availability of information alternatives (external and internal) and transfer decision

Apparently, it makes a difference whether an alternative information source available to the inquirer is an external or an internal one. The possibility that the inquirer could develop similar information internally seems to be of less significance than the prospect of his using other external information sources. How can this be explained?

It seems that information owners expect information seekers to try to cover their informational needs through external sources rather than through internal research and development activities. A reason might be that internal measures in general cause directly observable monetary and time expenditures. These costs may discourage activities geared towards generating the needed information internally. In addition, it is not certain that internal measures will really lead to the development of a comparable piece of know-how. Such costs and risks do not occur in the case of informal external acquisition of information. (Relating to external information sources another risk exists, the risk that external sources cannot or do not provide the needed information.)

To sum up, the empirical evidence leads to the conclusion that the availability of other external information sources to the information inquirer has a significant impact on the transfer decision of the information owner. This makes economic sense since a transfer of information which would have been available to the inquirer anyway does not reduce considerably the information's value to its original owner.

4.2 Instrumentality of the Relationship

In the preceding section, the discussion has concentrated on the change of the information's value caused by a transfer. In some instances, an information transfer reduces the competitive value of the information, thus creating a loss for the transferring firm. Yet, this loss might be balanced or even more than balanced by a benefit connected with the transfer: the transfer might increase the likelihood that the transferring company itself receives valuable information from the inquirer in the future. This informational benefit which the information owner expects to gain from his relationship with the inquirer is called instrumentality. In the following, factors influencing the instrumentality of an exchange relationship will be investigated.

The informational benefit which the information owner can expect to gain from an exchange relationship with the inquirer depends upon two factors: first, the inquirer's pool of technological knowledge, and, second, the inquirer's willingness to share this knowledge. The information owner will only gain from an exchange relationship with the inquirer if the inquirer has some know-how which might be of value to the information owner and is willing to share this know-how.

4.2.1 Inquirer's Willingness to Reciprocate Information

The proposition -- the information transfer between companies amounts to know-how trading -- implies that the involved parties enter into an exchange relationship. Such a relationship is generally characterized by a delicate balance of benefits and contributions:

"In exchange relationships, each person is concerned with how much he or she receives in exchange for benefitting the other and how much is owed the other in return for the benefits received."¹

In an exchange relationship, one party is contributing with the expectation that the receiving party will feel obliged to reciprocate the received favor, even without an explicit agreement.² There are two approaches for explaining this: The economic oriented approach argues that a party receiving a benefit would weaken the relationship if it did not return the favor, and would thereby lessen its own chance of receiving possible future benefits. This is the underlying assumption of von Hippel's explanation of the development of cooperative information-trading relationships.³ The second approach for explaining exchange relationships builds on the equity theory.⁴ This approach proposes that social regulative mechanisms rather than egoistic motives are responsible for balancing benefits and contributions.

Independently of the approach being used for explaining dynamics of exchange relationships, the literature proposes, first, that an information transfer is likely to increase the probability that the receiver himself will provide information in the future. Second, the literature suggests that the change of the receiver's willingness to reciprocate information depends also upon the value of the information which he receives: the more important the information for the

¹ Mills/Clark, 1982, S. 125.

² Macaulay, 1963; Levine/White, 1968.

³ Von Hippel 1987 and 1989.

⁴ Adams, 1965; von Rosenstiel, 1975; Perlman/Fehr, 1986.

receiver, the stronger will be his obligation to reciprocate and the greater the future benefit for the information provider.¹

In order to test these two hypotheses, the surveyed employees were asked to indicate to what extent they expected their transfer decision to change the inquirer's willingness to provide information to them in the future.

The first hypothesis -- an information transfer increases the provider's likelihood of receiving information from the other party in the future -- is strongly supported by the data. In 71 per cent of the transfer cases the employees assumed that providing the requested information would improve their likelihood of receiving information in return. In 32 per cent of the no-transfer situations they expected that the refusal to transfer would reduce the degree of cooperativeness in the respective relationship (Table 3).

	much less likely to reciprocate information			no change		much more likely to reciprocate information			
	1	2	3	4	5	6	7	n.a.	Σ
Transfer	0	0	0	33	15	40	30	1	119
No transfer	1	9	17	48	1	1	0	8	85

Table 3: Expected change of the inquirer's willingness to reciprocate caused by the transfer decision (number of cases)

The second hypothesis, relating to the influence of the value of the transferred information, is also supported by the data, as can be concluded from Table 4: In 58 per cent of the cases in which employees had transferred information of low importance² to their own companies, they expected no or only

¹ Mills/Clark, 1982; Clark, 1985; von Hippel, 1987.

² In these cases the employee indicated a value of 3 or less on a 7-point scale with 1 meaning "not at all important" and 7 meaning "very important". If the employee indicate a value above 5, then the information was classified as being of high importance. In the remaining cases the information was classified as being of medium importance. Two of the 119 transfer cases had to be omitted due to missing data.

a very small change in the inquirer's willingness to reciprocate information (indicated value 4 or 5). This looks different for the cases in which information of high importance had been transferred. 67.4 per cent of the employees who had transferred information which they considered to be of high importance to their company expected that the transfer would make it considerably more likely to receive information from the inquirer in the future (indicated value: 6 or 7).

Importance of transferred information to company of transferring employee	Expected change of inquirer's willingness to reciprocate information				Σ
	no change 4	5	6	much more likely to reciprocate 7	
• low	25.0%	33.3%	29.1%	12.5%	100% (n=24)
• medium	28.0%	12.0%	36.0%	24.0%	100% (n=50)
• high	30.2%	2.3%	32.6%	34.8%	(100%) (n=43)

Chi-square = 15.1; $p < 0.05$

Table 4: Importance of the transferred information and expected change of the inquirer's willingness to reciprocate

In the light of this evidence, a relationship between the value of the transferred information and the information receiver's willingness to reciprocate can be conjectured. But it is interesting to note that this relationship does not always hold true. In nearly one third of the cases relating to a transfer of information that was regarded as being of high importance, the surveyed employee did not expect this transfer to change the relationship to the inquiring

party. How can this be explained? One reason could be that the employees have already exchanged information with each other in the past and that therefore the described transfer did not change the relationship anymore. This assumption is supported by the data. Relationships which have already existed for an extended period of time are less affected by a single transfer decision than newer relationships. (The correlation between the expected change of the information receiver's willingness to provide information and the length of the relation ship is $r=-0.24$; $p<0.01$). Apparently, relationships develop over time and become more and more independent of single transfer decisions.

To sum up, the observed information transfers show more the characteristics of information *exchange*, or as von Hippel calls it "know-how trading", than of random information *leakage*. Information is provided with the expectation of receiving information in return.

4.2.2 Inquirer's Know-How Pool

Even if the inquirer is eager to reciprocate, his cooperativeness remains without value to the information owner if the inquirer cannot return information which is of relevance. Information is of relevance to a company if it helps to cover an informational need and if the information is not easily accessible from other sources, that is, if the information is not common knowledge or is at least unknown to this specific company.

It can be expected that the amount of exclusive know-how which a company controls increases with its research and technology orientation. Therefore, it should be more in the interest of a company to exchange information with another company which is at the forefront of technological development than to have an information exchange relationship with a firm that barely manages to keep up with technological advance.

The larger the technological expertise of the inquiring party is, the greater is the possibility that some element of the inquirer's information pool might be of value to the company facing the transfer decision. Consequently, it can be

hypothesized that the likelihood of an information transfer increases with the amount of technological expertise of the inquiring party.

For testing this hypothesis, two measures of technological expertise were used: the surveyed managers were asked (a) to rate the technological know-how of the inquirer personally, and (b) to indicate the degree to which the inquiring company is a technological leader within the industry. As can be expected, these two variables correlate positively with each other ($r=0.45$, $p<0.001$).

As hypothesized, transfer situations are characterized on average by a larger degree of technical expertise of the inquirer than no-transfer situations. A similar, but this time not significant finding can be reported for the variable measuring the technological leadership of the inquirer's company (Figure 7).

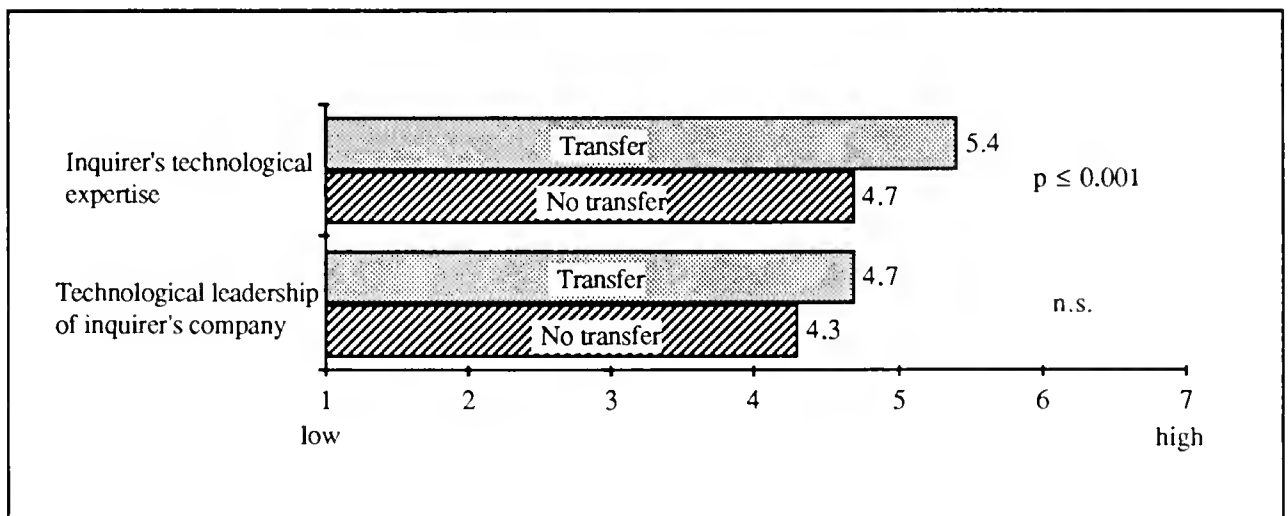


Figure 7: Technological expertise of the inquiring party and transfer decision.

It is not surprising that the inquirer's individual know-how pool is of more apparent importance to the transfer decision than the overall know-how basis of the company for which the inquirer is working. Receiving information obligates the individual person, rather than his company in general, to reciprocate the favor. Consequently, for the transfer decision, the individual's know-how pool is more decisive than that of the company represented by him.

It can be concluded that employees consider in their transfer decisions whether they can expect to receive in return information which is of potential benefit to their companies.

Drawing together the results which have been presented so far, we can conclude that, on average, employees' information exchange behavior is directed towards their companies' interest. Employees are apparently not "leaking" information but are rather consciously exchanging information, taking their companies' interest into account.

5 Informal Information Transfer and Companies' Performance

So far it has been shown that the information exchange behavior of individuals is, on average, directed towards their companies' economic interest. Now the question to be addressed is whether the informal information transfer creates an observable benefit for the companies.

Technological advance combined with competitive pressures make it necessary for companies continually to upgrade and to enhance their technological know-how. At the same time, resources are limited. Consequently, companies may not be able to generate internally all the technical knowledge they wish to have. In many cases, securing a firm's competitiveness necessitates external acquisition of technical knowledge.

Yet, explicit, contractual technology transfer is, in general, very costly. Usually, formal information transfer agreements are highly complex legal constructs that confront and must try to break the information paradox.¹ This kind of information transfer creates considerable transaction costs. High transaction costs explain why only a few companies use some formalized

¹ If the information to be transferred is precisely specified in the contract, then it is basically already transferred. But without such specifications, it is nearly impossible for the potential recipient to estimate the value of the information. Arrow, 1974, pp. 36-37.

technology transfer process and why only a small fraction of available information is transferred this way.¹

Unlike to formal information transfer, informal information transfer entails limited transaction costs. In particular, contracting costs and control and enforcement costs are insignificant in comparison to the formal transfer: No lengthy negotiations are required and no costly legal institutions are necessary for monitoring the information exchange. These simplifications are made possible at the expense of legal mechanisms that could be used to force the trading party into fulfilling its obligations. Fortunately, other, less costly control mechanisms do exist. For example, news about uncooperative behavior of a player supposedly travels fast within most industries. Thus, by not cooperating in one relationship a player puts several relationships in jeopardy -- a strong mechanism for enforcing cooperation.

There are conceivably many circumstances under which an information exchange would be in the economic interest of the involved companies, but under which formal transfer mechanisms are ruled out because they are too expensive. Firms which are then not using informal information exchange are sacrificing an important information source.

Information leading to small, incremental improvements is especially likely to fall into this category. Several empirical investigations have shown that such information in its entirety can be of considerable importance to a company's economic success.² Consequently, companies which do participate in the informal information transfer should be expected to be, *ceteris paribus*, more successful than companies which do not employ this means for acquiring and utilizing information.

The questionnaire survey offers evidence against which this hypothesis can be tested. The surveyed managers were asked to indicate the general propensity of their companies to participate in the informal exchange of technical information. In addition, they were asked to rate the economic success of their

¹ Grefermann/Röthlingshöfer, 1974, pp. 91-93 and Reid/Reid, 1987, p. 96.

² Enos, 1962; Hollander, 1965; Gold, 1979.

companies in comparison to the industry average by using a 7-point scale, with 1 meaning a "well below" and 7 a "well above average" economic performance.

The finding suggests a connection between a company's inclination to participate in informal information transfers and its economic performance. The degree to which a company's employees participate in the informal information exchange correlates positive ($r=0.19$; $p<0.001$) with the company's economic success as evaluated by the surveyed employee.

Managers who were working for companies that did not participate in the informal information exchange indicated, on average, a significantly lower economic performance for their companies (mean=4.7) than managers whose companies did actively participate in this kind of information transfer (mean=5.8; $p<0.001$; see Table 5).

Participation in the informal information transfer between companies	Economic success (mean)	Number of surveyed managers
1 (=no participation)	4.68	16
2	4.93	30
3	5.25	39
4	5.71	68
5	5.26	55
6	5.77	48
7 (=active participation)	5.82	27

Table 5: Average economic success contingent on the participation in the informal information exchange

In summary, the survey offers suggestive evidence for a link between a company's economic performance and its employees' participation in the informal information transfer. It has to pointed out that the survey itself cannot

determine what is the cause and what is the effect. But given that employees' information exchange behavior appears to be oriented towards their companies' benefit, then it can be argued that the participation in the informal information transfer is likely to drive the economic performance of the companies.

6 Conclusion

The conceptual considerations and the empirical data presented in this paper lead to the following conclusion: The proposition that informal, person-to-person information transfer between companies opposes the economic interest of the involved firms has to be rejected. On the contrary, observed information transfers show characteristics of information trading rather than leakage. In the analyzed industry, they apparently contribute to the economic success of companies and of the industry as a whole, since they encourage efficient use of the industry's know-how base.

However, if such informal information transfer really can create a positive contribution, why then is it generally being neglected and even opposed by the managerial and economic literature?

Three reasons might explain this phenomenon. First, in informal information exchange, the transfer and return transfer are often temporally separated without being connected to each other by an easily observable contractual arrangement. Taking a snap-shot picture of the relationship, the observer may get the impression that the transferring party is giving up something without receiving a benefit in return. In other words, the observer may not recognize the long-term balance of giving and receiving.

Second, the theoretical considerations presented in this paper have shown that there are some situations in which information transfer pays, and others in which it might actually harm the companies. The information content, the competitive relationship between the companies, the availability of other information sources, and the exchange partner's ability and willingness to return valuable information all have an important impact on the advantageousness of a

specific information transfer. In general, such a differentiated analysis has not been done in the literature. Only obvious cases in which information transfer harms companies have been discussed and implicitly generalized to all transfer situations.

Third, a number of empirical investigations have revealed that subjects are often so focused on competition that they are trying to maximize the relative distance between themselves and their competitors and do not concentrate on their own welfare.¹ Yet, the basic principle of cooperative relationships (such as information exchange) is that one's own welfare is being fostered by measures which at the same time help the partner. Sometimes the strong emphasis on competition apparently prevents the recognition of possibilities for cooperation. But these empirical investigations have also shown that subjects tend to turn towards cooperation once the effects of excessive competition become obvious.

The findings presented in this paper open up several interesting questions to be addressed by future research: First, can know-how trading be observed in other industries as well? Anecdotal evidence by von Hippel and others suggests that it is a wide spread phenomenon in some industries and virtually non-existing in others.² Second, what causes the apparent alignment of individuals' behavior and companies' interest in the steel industry? One important factor might be the possibility to evaluate employees' performance in terms closely linked to companies' success. The surveyed employees' responsibilities encompassed such tasks as melt-shop supervision and rolling mill management. For evaluating the performance of these employees, companies can turn to such measures as production efficiency and product quality -- measures which have a significant impact on the economic well-being of the companies. Therefore, it is in the interest of an employee to improve the performance of his company on these dimensions, both in absolute terms and relative to other companies. This leads to the question if employees' information transfer behavior differs in industries

¹ Crott, 1979, pp 142-143.

² Von Hippel, 1987; Gravilis, 1989.

where it is more difficult to relate an individual's performance to the company's success -- a question to be addressed by future research.

Informal information transfer between companies is a way of cooperation, a way which can coexist with market mechanisms. The involved companies can still compete with each other in the marketplace. Yet, at the same time, they can employ their technical know-how more efficiently through selective cooperation: Gained technical know-how is not only used within one company, but also is bartered for further knowledge -- as long as the know-how is not central to the company's competitive position. Thereby, informal information transfer can contribute to companies' economic performance. At the same time, such transfer of information is desirable from society's point of view since it avoids redundant research activities.

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